US008216445B2

(12) **United States Patent**
Anderson et al.

(10) **Patent No.: US 8,216,445 B2**
(45) **Date of Patent: Jul. 10, 2012**

(54) **NANOPOROUS INSULATING OXIDE DEIONIZATION DEVICE HAVING ASYMMETRIC ELECTRODES AND METHOD OF USE THEREOF**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1287 days.

(21) Appl. No.: **11/932,741**

(22) Filed: **Oct. 31, 2007**

(65) **Prior Publication Data**

US 2008/0121531 A1 May 29, 2008

Related U.S. Application Data

(60) Provisional application No. 60/855,666, filed on Oct. 31, 2006.

(51) **Int. Cl.**

H01G 9/042	(2006.01)
H01G 9/045	(2006.01)
H01G 9/048	(2006.01)
C02F 1/469	(2006.01)
C02F 1/58	(2006.01)

(52) **U.S. Cl.** **205/701**; 205/688; 205/703; 205/746; 205/754; 205/759; 205/760; 205/770; 361/503; 361/504; 361/505

(58) **Field of Classification Search** ..... None
See application file for complete search history.

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(57) **ABSTRACT**

A nanoporous insulating oxide deionization device, method of manufacture and method of use thereof for deionizing a water supply (such as a hard water supply), for desalinating a salt water supply, and for treating a bacteria-containing water supply. The device contains two composite electrodes each constructed from a conductive backing electrode and a composite oxide layer being an insulating oxide or a non-insulating oxide and an intermediate porous layer. The composite layer being substantially free of mixed oxidation states and nanoporous and having a median pore diameter of 0.5-500 nanometers and average surface area of 300-600 m^2/g. The composite layer made from a stable sol-gel suspension containing particles of the insulating oxide, the median primary particle diameter being 1-50 nanometers. The difference in zeta potential, at a pH in the range of 6-9, being sufficient to suitably remove alkaline and alkaline earth cations (such as Ca^{2+} and Na^{1+}), various organic and other inorganic cations and organic and inorganic anions from water, preferably household hard water. One composite layer being constructed from a mixture of Al_2O_3, $MgAl_2O_4$ and/or Mg-doped Al_2O_3 particles, and the other composite layer being constructed from SiO_2 or TiO_2.

37 Claims, 10 Drawing Sheets